Dunlin (*Calidris alpina*) in Utqiagvik, Alaska, USA; Lisa Hupp, USFWS (CC)

Using shorebird tracking data to support a documentary focused on the global importance of the Arctic Coastal Plain for waterbirds

Conservation Contribution #11

Conservation Action: Education and Awareness

Prepared by the Shorebird Science & Conservation Collective:

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January 2024

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Project Background

Conservation Request

The Cornell Lab of Ornithology (hereafter, "Cornell") requested shorebird tracking data from the Shorebird Science and Conservation Collective (hereafter, "Shorebird Collective") to support the production of a film highlighting the global significance of the Arctic Coastal Plain in Alaska, USA (**Figure 1a**) for waterbirds, particularly near Teshekpuk Lake (**Figure 1b,** web link for the film). Specifically, Cornell requested maps displaying movement paths from electronically tracked American Golden Plover (*Pluvialis dominica*), *arcticola* Dunlin (*Calidris alpina arcticola*), and Pectoral Sandpiper (*C. melanotos*, see page 13 for more information on tracking data) to feature as track animations in a section showcasing the fall migrations of species dispersing from the region. The Shorebird Collective provided example southbound movement paths for the above species (**Figure 2**) for Cornell to transform into track animations in their film.

About the Shorebird Science and Conservation Collective

The Shorebird Collective is a partnership of scientists and practitioners working to translate the collective findings of shorebird tracking and community science data into effective on-the-ground actions to advance shorebird conservation in the Western Hemisphere. Learn more on our webpage: web link for the Shorebird Collective's webpage.

About the Cornell Lab of Ornithology

The Cornell Lab of Ornithology, based at Cornell University, is dedicated to the study and conservation of birds. Cornell's lab has played a pivotal role in advancing ornithological research, education, and outreach, and serves as a central hub for scientists, educators, and bird enthusiasts alike. Through cutting-edge research, citizen science initiatives, and innovative technology, Cornell contributes significantly to our understanding of avian life. Learn more on Cornell's website: web link for the Cornell Lab of Ornithology's website.

American Golden-Plover (*Pluvialis dominica*); Lisa Hupp, USFWS (CC)

Dunlin (*Calidris alpina*); Dow Lambert, USFWS (CC)

Pectoral Sandpiper (*Calidris melanotos*); Lisa Hupp, USFWS (CC)

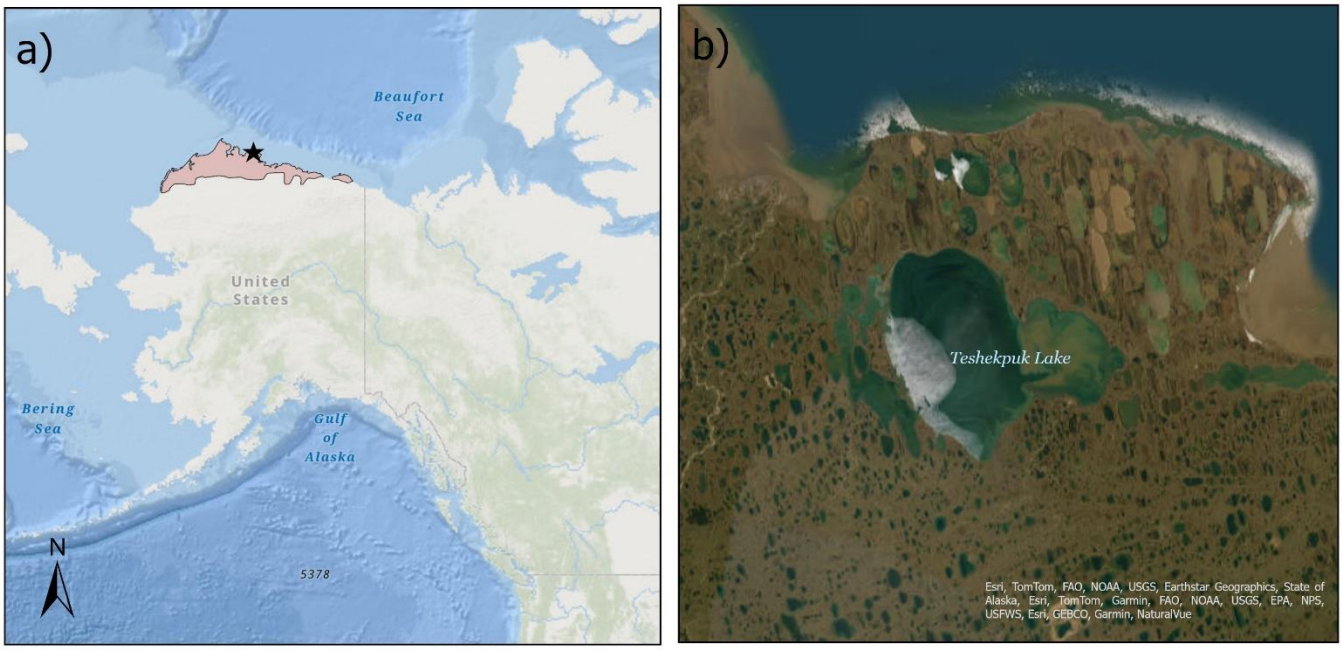


Figure 1. a) Location of the Arctic Coastal Plain (pink polygon, EPA Level III Ecoregion [U.S. EPA 2013]; i.e., Cornell's area of interest for their film) in Alaska, USA. The star indicates the location of Teshekpuk Lake (1b); **b)** Aerial map of the Teshekpuk Lake area in Alaska, USA. EPA Level III Ecoregions (U.S. EPA 2013) are also shown to provide additional context of the state's landscapes.

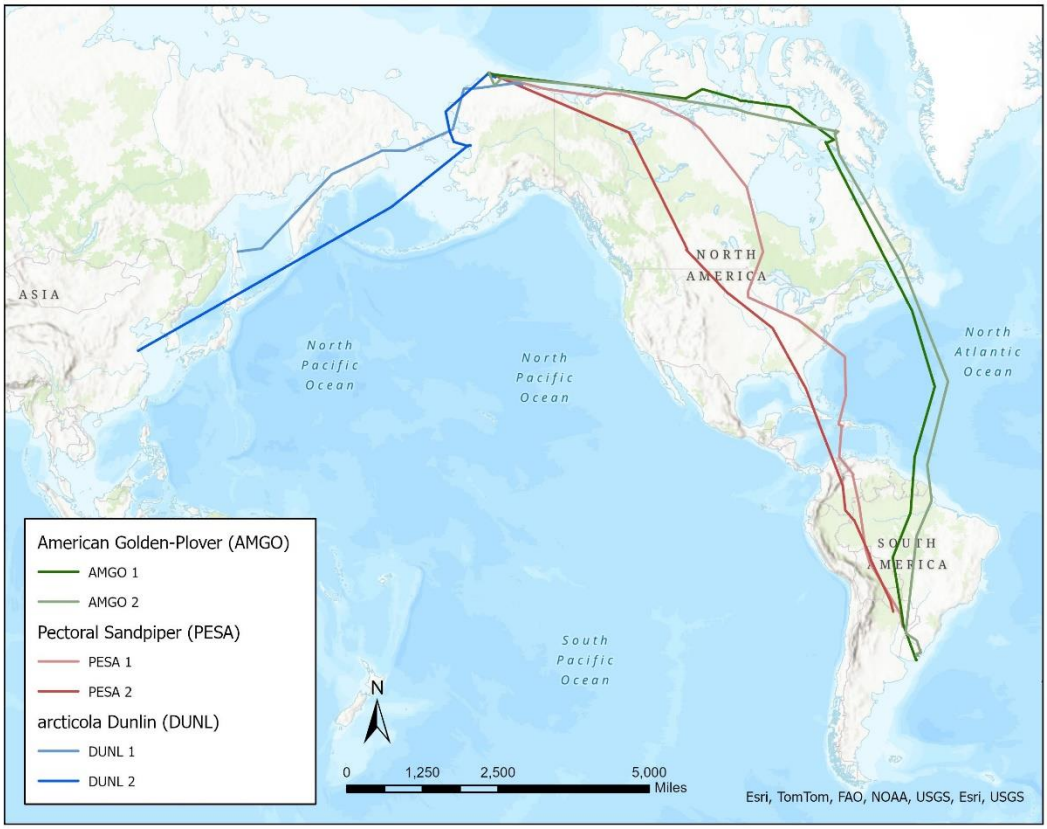


Figure 2. Southbound migratory routes of electronically tracked American Golden Plover (*Pluvialis dominica*), *arcticola* Dunlin (*Calidris alpina arcticola*), and Pectoral Sandpiper (*C. melanotos*) provided to Cornell for their track animations. The Shorebird Collective provided Cornell with individual maps displaying each track separately. Tracking data contributed by Rick Lanctot, U.S. Fish and Wildlife Service. See page 15 for additional data contributor information.

About the Arctic Coastal Plain

The Arctic Coastal Plain (ACP) is a vast expanse of Arctic lowland tundra in northern Alaska, encompassing portions of the National Petroleum Reserve – Alaska and Arctic National Wildlife Refuge (**Figure 3**), two critically important areas for biodiversity (Amundson et al. 2019, Bart et al. 2013). The ACP is characterized by an extensive array of wetlands that provide critical habitat for millions of shorebirds and other waterbirds as they breed or migrate through the area annually (Bart et al. 2013, Johnson et al. 2007). Additionally, the ACP is home to several of North America's larger terrestrial mammals, including musk ox, caribou, moose, polar bears, and wolves (Gryc 1985). The ACP also hosts some of the planet's largest oil and gas reserves (Brownfield et al. 2012), leading to extensive oil and gas exploration and production (Harsem et al. 2015, Hayes 2015). These activities, paired with the already growing impacts of climate change (Harsem et al. 2015), have potential to significantly alter the landscape and impact the wildlife populations dependent on the landscape (Amundson et al. 2019). Growing research in recent years has focused on identifying wildlife trends and hotspots to inform oil and gas leasing decisions and mitigate their impacts (e.g., Amundson et al. 2019, Bart et al. 2013, Wilson et al. 2018).

Aerial view of the Arctic Coastal Plain; Lisa Hupp, USFWS (CC)

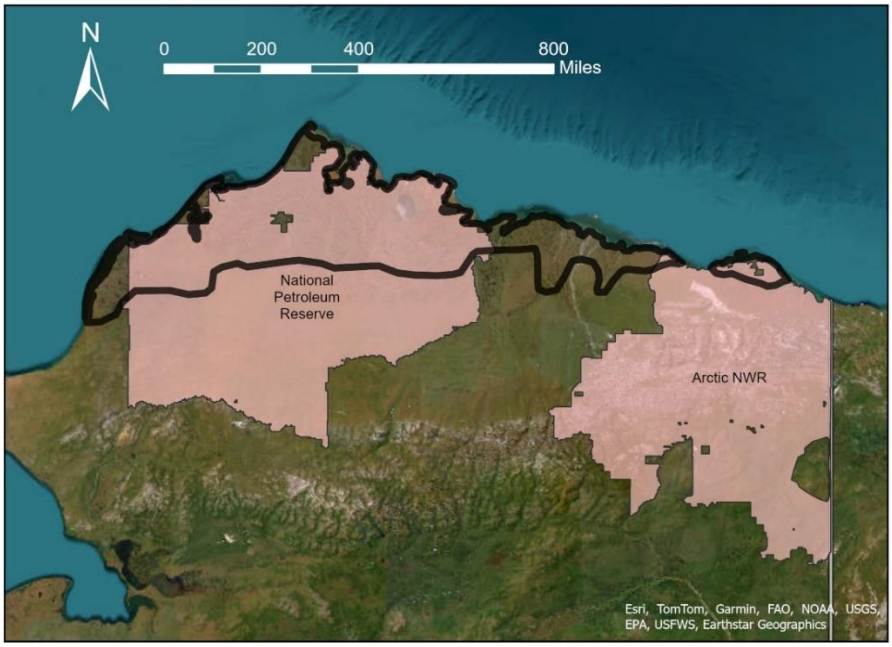


Figure 3. Aerial map of the Arctic Coastal Plain (EPA Level III Ecoregion [U.S. EPA 2013]), located in nothern Alaska, USA. The light pink polygons show the boundaries of the National Petroleum Reserve and Arctic National Wildlife Refuge, both of which are partially located within the coastal plain region .

About the Shorebirds Tracked in the Arctic Circle Plain

Tracked American Golden-Plovers

The Shorebird Collective shared movement paths of two American Golden-Plovers with Cornell for their animations. The plovers were equipped with GPS tracking devices on their breeding grounds near Utqiagvik, Alaska, USA (**Figure 8**) in late-June 2019 (Plover 1, ID: 179687) and 2021 (Plover 2, ID: 20060). Both individuals were tracked in the Arctic Coastal Plain through the end of July before migrating 9,500 miles south to their wintering grounds in Rocha, Uruguay (**Figure 9**).

About American Golden-Plovers

American Golden-Plovers are medium-sized shorebirds with a short, straight bill and long pointed wings (Johnson et al. 2021). Breeding adults have black and white plumage with mottled black and gold upperparts (Johnson et al. 2021). As long-distance migrants, they breed on tundra in the Arctic and winter primarily in Argentina and Uruguay (Johnson et al. 2021). Known for their elliptical migration pattern, individuals fly a nonstop offshore route over the Atlantic Ocean in the fall and midcontinental route in the spring. Across their vast range they use a variety of inland and coastal habitats, including agricultural fields, pastures, native prairie, mudflats, estuaries, and shorelines (Johnson et al. 2021).

American Golden-Plover (*Pluvialis dominica*); Jared Hughey, NPS (CC)

American Golden-Plover Facts

- American and Pacific Golden-Plovers were once thought to be a single species known as the Lesser Golden-Plover. They were later recognized as separate species due to differences in vocalizations and nesting habitat and absence of interbreeding in areas where populations overlap (Connors et al. 1993).
- American Golden-Plovers are fast fliers, reaching flight speeds of up to 60 miles per hour (Johnson et al. 2021).

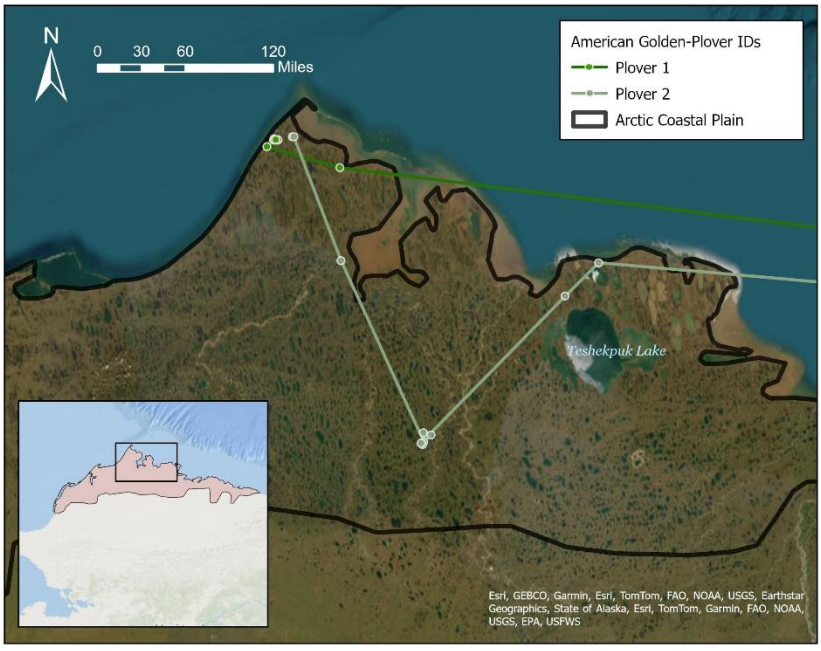


Figure 4. GPS locations of the two tracked American Golden-Plovers (*Pluvialis dominica*) in the Arctic Coastal Plain (EPA Level III Ecoregion [U.S. EPA 2013]) shared with Cornell. Both individuals were equipped with GPS tracking devices by a team of scientists in late June 2019 and 2021. Both were tracked in the region through the end of July before migrating south. Figure 5 provides details of their southbound migratory movements. American Golden-Plover tracking data were contributed by Rick Lanctot, U.S. Fish and Wildlife Service. See page 15 for additional data contributor information.

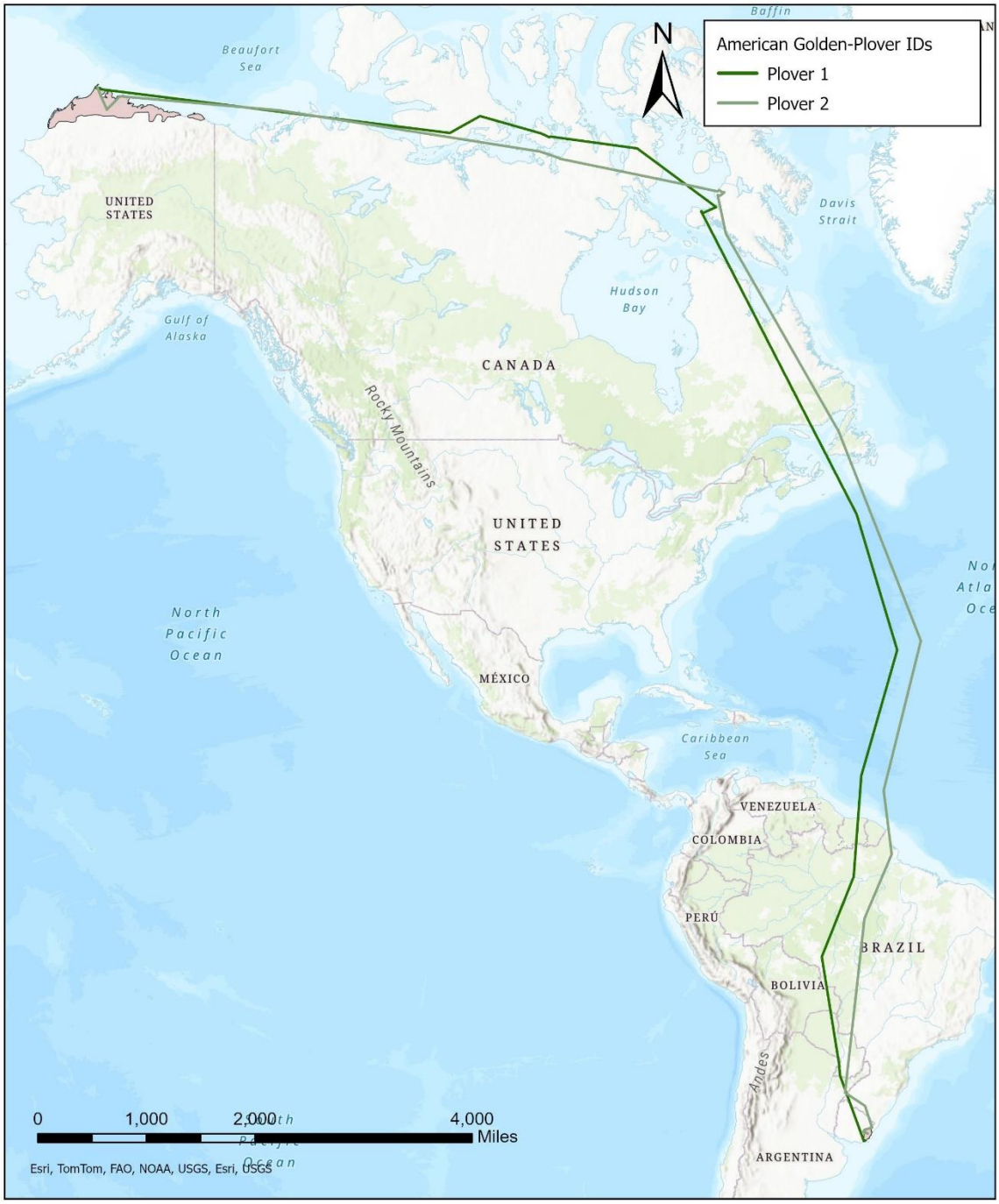


Figure 5. Southbound migratory routes of the two tracked American Golden-Plovers (*Pluvialis dominica*) shared with Cornell. Both individuals flew 9,500 miles south to their nonbreeding grounds in Rocha, Uruguay. American Golden-Plover tracking data contributed by Rick Lanctot, U.S. Fish and Wildlife Service. See page 15 for additional data contributor information.

Tracked *arcticola* Dunlins

The Shorebird Collective shared movement paths of two *arcticola* Dunlins with Cornell for their animations. The Dunlins were equipped with GPS satellite tags on their breeding grounds near Prudhoe Bay (Dunlin 1, ID: 41795) and Utqiagvik (Dunlin 2, ID: 41852), Alaska, USA (**Figure 6Figure 8**) in mid-June 2017. Both individuals were tracked in the Arctic Coastal Plain through mid-September before migrating 2,700 (Dunlin 1) and 4,700 (Dunlin 2) miles southwest to their wintering grounds in Sakhalin Oblast, Russia and Jiangsu Sheng, China (**Error! Not a valid bookmark self-reference.**).

About *arcticola* Dunlins

Dunlins are a medium-sized shorebird with a stocky body and long, drooping bill (Warnock and Gill 2020). Breeding adults have a black belly and rufous mottled back (Warnock and Gill 2020). As an intermediate- to short-distance migrant, the *arcticola* subspecies breeds on tundra in the Arctic and winters in eastern China, Korea, and Japan (Warnock and Gill 2020). Throughout their range they use moist habitats, including shorelines, beaches, shallow wetlands, marshes, tidal flats, flooded fields, and mudflats (Warnock and Gill 2020).

Dunlin Facts

- Ten Dunlin subspecies are currently recognized worldwide based on differences in plumage, size, and shape (Warnock and Gill 2023). The three subspecies in North America include *pacifica* (southwestern Alaska), *hudsonia* (central Canadian arctic), and *arcticola* (northwestern Alaska/Canada, Warnock and Gill 2023).
- Males attract mates through a series of display flights consisting of short glides with arched, stiff wings interspersed with rapid flutters (Warnock and Gill 2023).

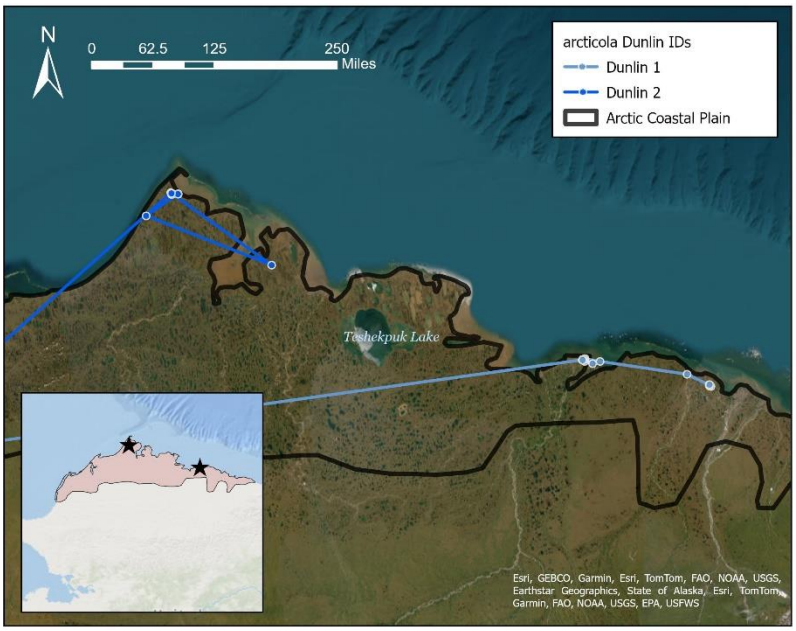


Figure 6. GPS locations of the two tracked *arcticola* Dunlin (*Calidris alpina arcticola*) in the Arctic Coastal Plain (EPA Level III Ecoregion [U.S. EPA 2013]) shared with Cornell. Both individuals were equipped with GPS tracking devices by a team of scientists in mid-June 2017 and were tracked in the region through mid-September before migrating south. Figure 7 provides details of their southbound migratory movements. *arcticola* Dunlin tracking data were contributed by Rick Lanctot, U.S. Fish and Wildlife Service. See page 15 for additional data contributor information.

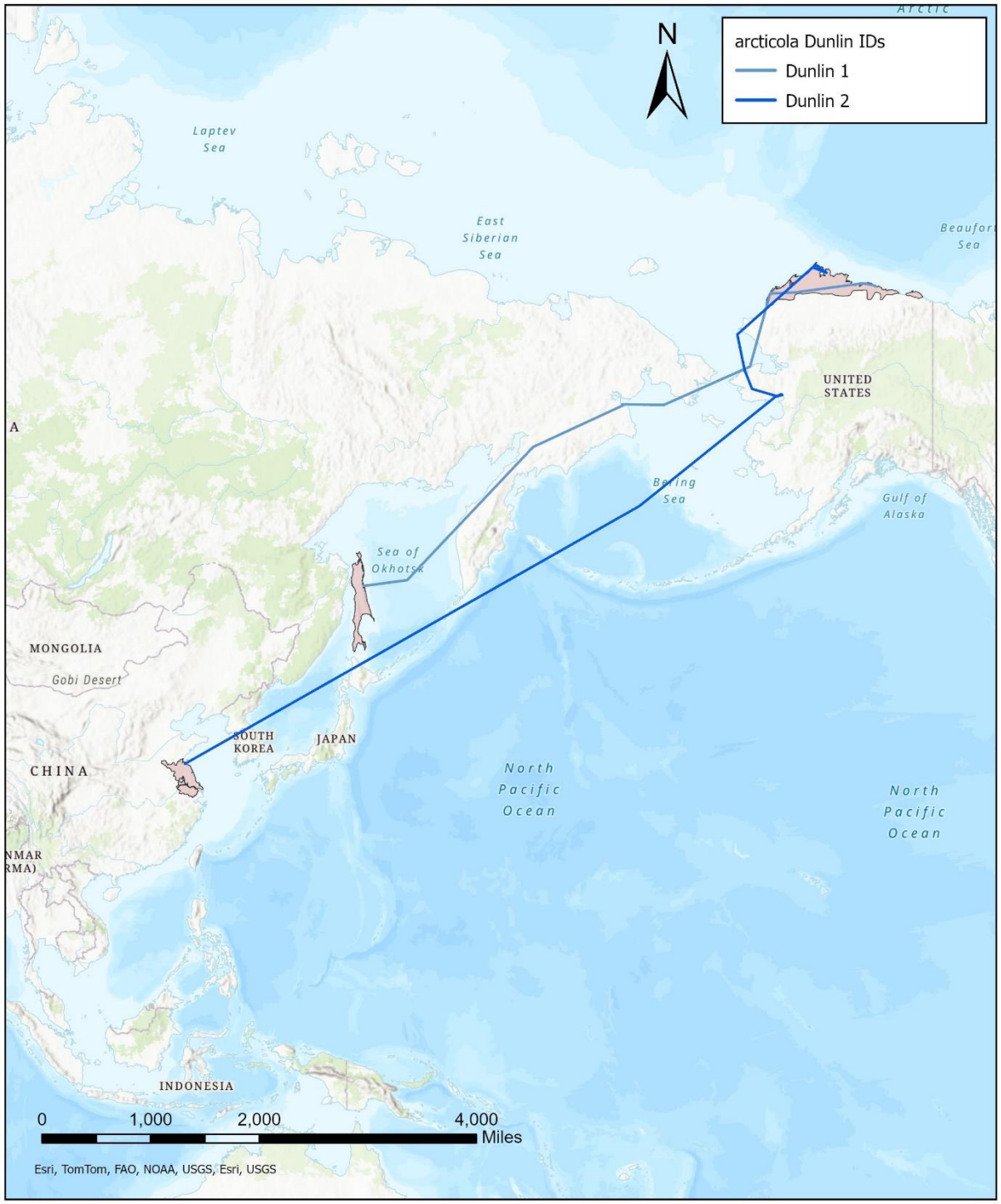


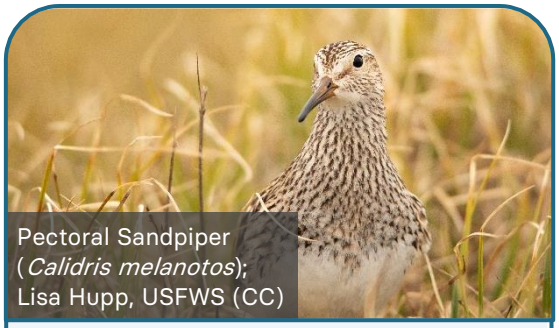
Figure 7. Southbound migratory routes of the two tracked *arcticola* Dunlin (*Calidris alpina arcticola*) shared with Cornell. The two individuals flew 2,700 (Dunlin 1) and 4,700 (Dunlin 2) miles southwest to their nonbreeding grounds in Sakhalin Oblast, Russia and Jiangsu Sheng, China. Tracking data were contributed by Rick Lanctot, U.S. Fish and Wildlife Service. See page 15 for additional data contributor information.

Tracked Pectoral Sandpipers

The Shorebird Collective shared movement paths of two Pectoral Sandpipers with Cornell. The sandpipers were equipped with GPS tracking devices on their breeding grounds in Utqiagvik, Alaska, USA (**Figure 8**) in mid-June 2018 (Sandpiper 1, ID: 175176) and 2019 (Sandpiper 2, ID: 180596). Sandpiper 1 was tracked in Utqiagvik until mid-July before migrating south, while Sandpiper 2 was tracked in the area until early August. Both individuals flew over 8,000 miles to their nonbreeding grounds in Corrientes (Sandpiper 1) and Formosa (Sandpiper 2), Argentina (**Figure 9**).

About Pectoral Sandpipers

Pectoral Sandpipers are medium-sized shorebirds with a brown streaked breast and white belly (Farmer et al. 2020). As long-distance migrants, they breed on tundra in the Arctic and winter in South America (Farmer et al. 2020). They use upland and wet grassland habitats, including grassy shorelines and marshes, flooded fields, and wet meadows (Farmer et al. 2020).



Pectoral Sandpiper (*Calidris melanotos*); Lisa Hupp, USFWS (CC)

Pectoral Sandpiper Facts

- Breeding males have an inflatable throat sac which puffs out during display flights to attract mates (Farmer et al. 2020). Males can go for weeks at a time without sleep during the courtship period (Lesku et al. 2012).
- Some Pectoral Sandpipers breed as far west as Siberia, Russia, making impressive 10,000+ mile journeys (one-way) as they migrate to and from their breeding and nonbreeding grounds (Farmer et al. 2020).

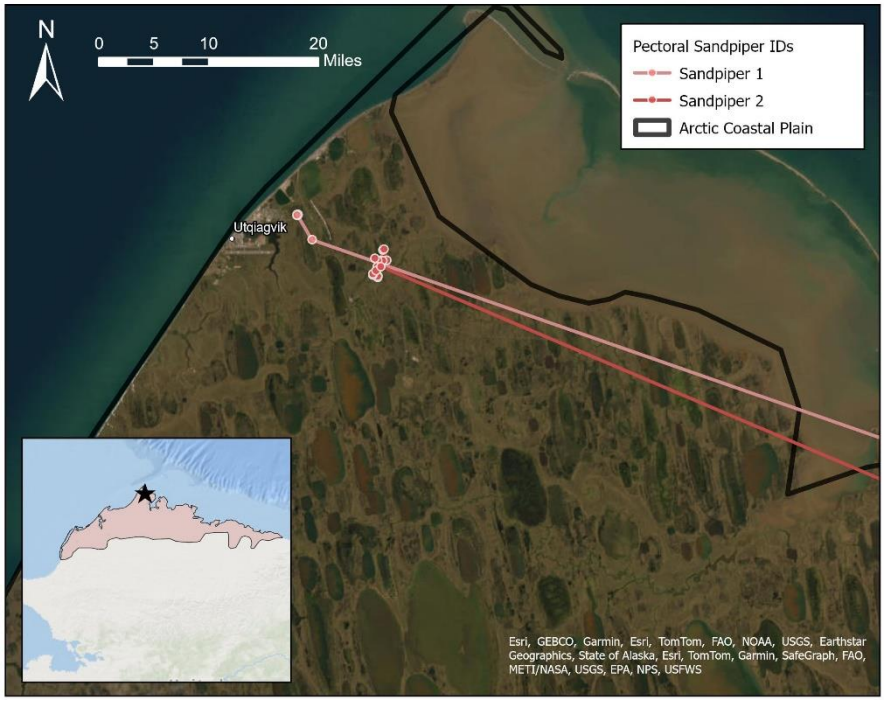


Figure 8. GPS locations of the two tracked Pectoral Sandpipers (*Calidris melanotos*) in the Arctic Coastal Plain (EPA Level III Ecoregion [U.S. EPA 2013]) shared with Cornell. Both individuals were equipped with GPS tracking devices by a team of scientists in mid-June 2018 and 2019. Sandpiper 1 was tracked in Utqiagvik, Alaska, USA until mid-July before migrating south, while Sandpiper 2 was tracked in the area until early August. Figure 9 provides details of their southbound migratory movements. Pectoral Sandpiper tracking data were contributed by Rick Lanctot, U.S. Fish and Wildlife Service. See page 15 for additional data contributor information.

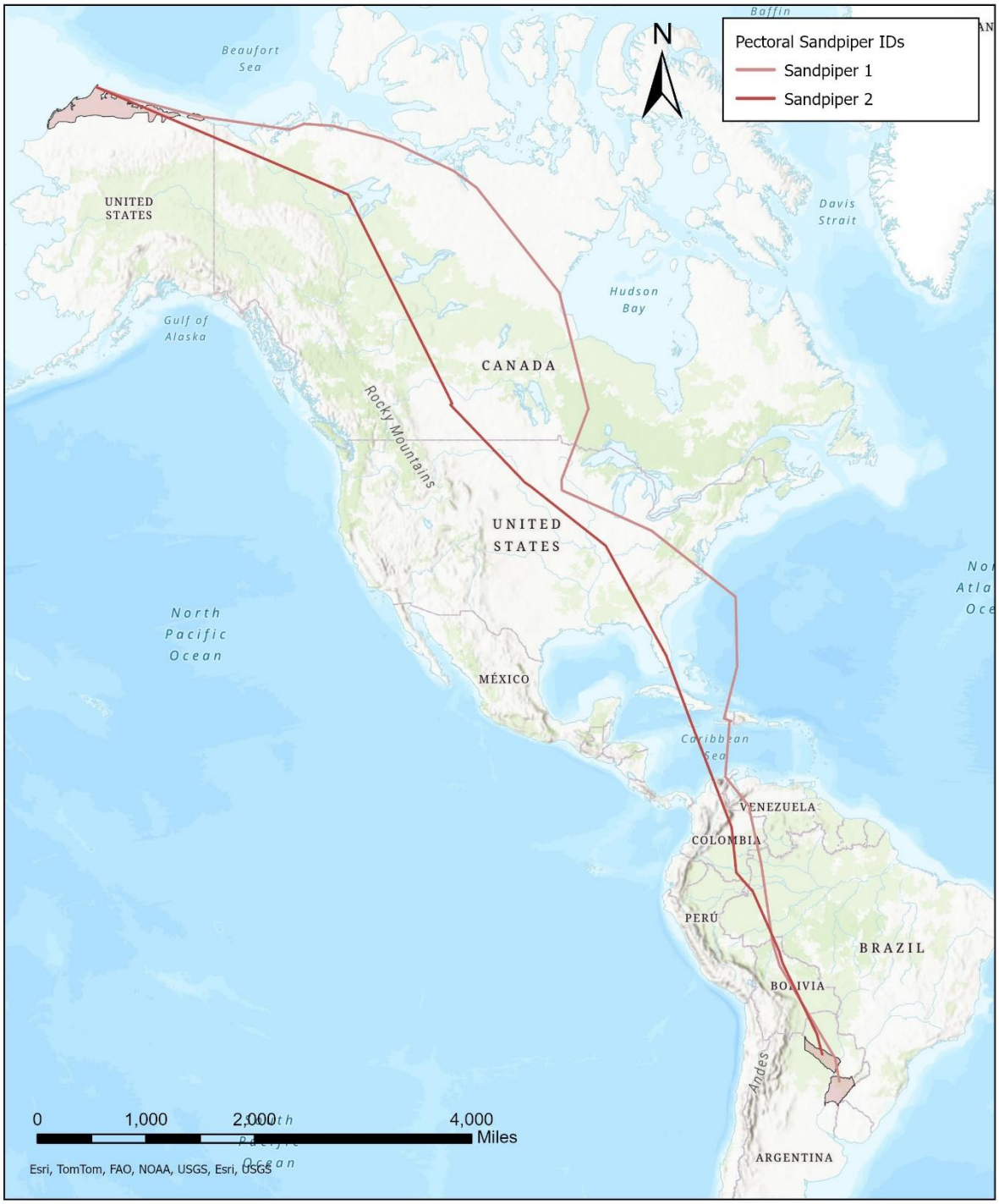


Figure 9. Southbound migratory routes of the two tracked Pectoral Sandpipers (*Calidris melanotos*) shared with Cornell for their animations. Both individuals flew over 8,000 miles to their nonbreeding grounds in Corrientes (Sandpiper 1) and Formosa (Sandpiper 2), Argentina. Pectoral Sandpiper tracking data were contributed by Rick Lanctot, U.S. Fish and Wildlife Service. See page 15 for additional data contributor information.

Shorebird Background

Shorebirds are a diverse group of birds in the order Charadriiformes, including sandpipers, plovers, avocets, oystercatchers, and phalaropes. There are approximately 217 shorebird species in the world (O'Brien at al. 2006), 81 of which occur in the Americas. 52 species breed in North America (Morrison et al. 2000) and 35 species breed in Latin America and the Caribbean (Lesterhuis and Clay 2019). They are among the planet's most migratory groups of animals. Many species in the Western Hemisphere, for example, travel thousands of miles every year between their breeding grounds in the Arctic and wintering grounds in the Caribbean and Central and South America, stopping at key sites along the way to rest and refuel. Across their vast range, shorebirds depend on a variety of habitats, including coastlines, shallow wetlands, mudflats, lake and pond edges, grasslands, and fields.

Long-billed Curlew (*Numenius americanus*); Tim Romano, Smithsonian

Although shorebirds are often seen in large flocks, it may surprise some to know that their populations are rapidly declining. Many populations have lost over 70% of their numbers in the past 50 years (NABCI 2022, Rosenberg et al. 2019, Smith et al. 2023), making them one of the most vulnerable bird groups in North America. Habitat loss and alteration, human disturbance, and climate change are just some of the major threats shorebirds face today. Effective shorebird management is even more of a challenge due to many species depending on habitats across multiple countries under different political jurisdictions. Despite these trends, many public and private groups are working to protect shorebirds and the habitats they depend on.

Flock of Marbled Godwits (*Limosa fedoa*) next to a shorebird scientist; Tim Romano, Smithsonian

Scientists attaching a GPS transmitter to a Red Knot (*Calidris canutus*) to track its migration; Tim Romano, Smithsonian

About Shorebird Tracking Data

Tracking data provide valuable insight into where shorebirds move and are located throughout the year (**Figure 10**). These data can ultimately help biologists and practitioners make more informed conservation and land management decisions to protect shorebirds and their habitats. Tracking data are collected via tiny electronic devices (often called "tags") which are attached directly to individual birds (typically with either leg bands, harnesses, or glue) and may be carried by the birds year-round. Data from shorebirds tracked with satellite tags were shared with Cornell.

Black-bellied Plover (*Pluvialis squatarola*) with <5 g solar satellite tag; Ryan Askren, USGS/Smithsonian

Satellite tags work by sending signals to orbiting satellites that re-transmit location data back to a receiving station which researchers can access through their computer. The two types of satellite tags commonly used to study birds include Global Positioning System (GPS) and Argos tags. GPS tags typically have high spatial accuracy (i.e., minimal location error, generally <10 meters), while Argos tags can have location error of 500-2,500 meters. The Shorebird Collective compiled contributed GPS satellite data to support Cornell's request. Web link for more information on satellite tags.

One key benefit of tracking data compared to other data types such as survey or count data is that they give detailed information on movements and habitat use of individual animals in areas that are otherwise difficult to access, such as remote areas or private lands. Therefore, the birds themselves show us where they are, independent of the need for direct human observation.

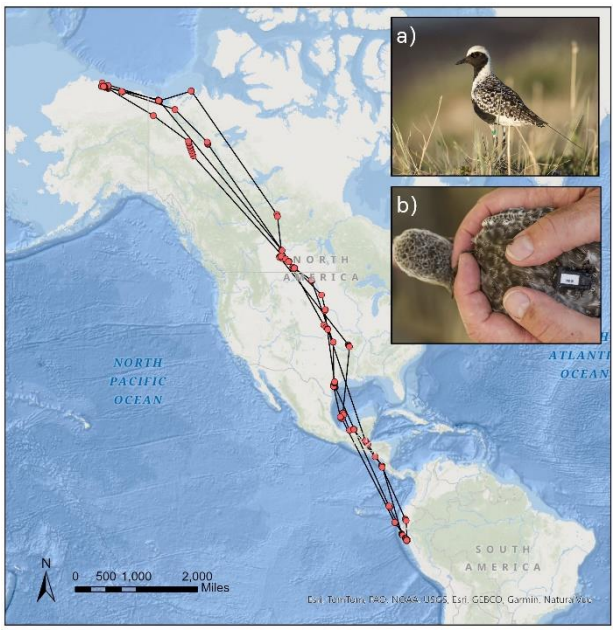


Figure 10. Full cycle track line across two years for an individual Black-bellied Plover (*Pluvialis squatarola*); contributed by Autumn-Lynn Harrison, Smithsonian Migratory Bird Center; David Newstead, Coastal Bend Bays & Estuaries Program; and Lee Tibbitts, U.S. Geological Survey, Alaska Science Center. Photos: **a)** Breeding male Black-bellied Plover with leg flag and <5 g solar satellite tag, Ryan Askren, USGS/Smithsonian; **b)** Satellite tag attached to the back of a Black-bellied Plover; Tim Romano, Smithsonian.

Using Education for Conservation Action

Education and outreach programs offer a unique opportunity to raise awareness about, and action towards, specific conservation concerns. Its application can increase knowledge, shape attitudes and values, build skills that prepare individuals to take positive conservation action, and foster engagement between community members, scientists, practitioners, and decision-makers (Ardoin et al. 2020).

Picking up trash on a beach; Tim Romano, Smithsonian

Cornell's documentary is an example of an outreach effort designed to raise awareness about the importance of the Arctic Coastal Plain for waterbirds. While not explicitly focused on shorebirds, the track animations provide a compelling narrative on the marathon migrations of shorebirds, which can inspire and engage viewers at an emotional level. With many shorebird populations in decline (NABCI 2022, Rosenberg et al. 2019, Smith et al. 2023), it is now more important than ever to spread knowledge about these birds.

When planning any conservation education program, lesson, or activity, efforts must be designed in a way that align with the participants' attitudes and values and framed in way that makes them care (Lakoff 2010). For example, the film's storytelling components and stunning visuals of the Arctic's diverse landscapes, an otherwise unfamiliar territory for many, can foster a deeper appreciation to the natural world and motivate viewers to take action to protect the natural landscapes in the region. Encouraging simple and manageable actions is often a first step to motivate change and initiate greater conservation action (Mengak et al. 2019, Schultz 2002). Relevant to helping shorebirds, there are several examples of simple and manageable "shorebird-friendly" actions that anyone can take or recommend to others.

Shorebird-Friendly Actions

1. **Avoid closed areas** – Avoid walking through roped or blocked off areas on beaches where shorebirds may be nesting.
2. **Keep dogs leashed** – Keeping dogs leashed at beaches will prevent them from rushing towards areas where shorebirds nest, rest, and feed.
3. **Don't get too close** – While it's exciting to get close to wildlife, being too close can disturb the birds. It's better to grab a pair of binoculars and observe from afar!
4. **Pick up trash** – Keeping beaches and other natural landscapes clean will prevent birds from choking or becoming entangled in trash. Garbage can also attract predators, which prey on shorebird eggs.
5. **Avoid pesticides** – Limit pesticide use around the home and yard as many are toxic to birds and other wildlife.
6. **Turn lights out** – Turning off excess lighting during the migration months will help shorebirds (and other migratory birds) become less disoriented while migrating.
7. **Protect wetlands** – Support the protection of your local wetlands, which provide important habitat for shorebirds.
8. **Share sightings on eBird** – Report your shorebird observations on eBird to help scientists better understand where shorebirds are and when, allowing for more effective conservation and land management efforts (web link for eBird)

Data Contributors

Tracking data for this project were contributed to the Shorebird Collective by the following people and organizations. Individuals with an asterisk (*) indicates the technical point of contact for the dataset. A full list of data contributors to the Shorebird Collective can be found on our webpage: web link for the Shorebird Collective's webpage.

American Golden-Plover Tracks

Rick Lanctot[1], Jean-François Lamarre[2,3], Joël Bêty[3], Rebecca McGuire[4], Sarah Saalfeld[1], Shiloh Schulte[5], Stephen Brown[5], Autumn-Lynn Harrison[6], Kyle Elliot[7], Marie-Andrée Giroux[8], Mike Russell[9], Paul Smith[10], Nicolas Lecomte[8], Pete Marra[11], Willow English[12]

Unpublished data: U.S. Fish & Wildlife Service; Polar Knowledge Canada, Canadian High Arctic Research Station; Université du Québec à Rimouski; Wildlife Conservation Society; Manomet; Smithsonian Migratory Bird Center; McGill University; Université de Moncton; Government of Alberta; National Wildlife Research Centre, Environment and Climate Change Canada; [11] Georgetown University; [12] Carleton University

arcticola Dunlin Tracks

Rick Lanctot[1], Sarah Saalfeld[1], Daniel Ruthrauff[13], and Rebecca McGuire[4]

Unpublished data: U.S. Fish & Wildlife Service; U.S. Geological Survey, Alaska Science Center; Wildlife Conservation Society

Pectoral Sandpiper Tracks

Rick Lanctot[1], Christopher Latty[1], Daniel Ruthrauff[13], Jean-François Lamarre[2,3], Rebecca McGuire[4], Sarah Saalfeld[1], Shiloh Schulte[5], and Stephen Brown[5]

Unpublished data: U.S. Fish & Wildlife Service; U.S. Geological Survey, Alaska Science Center; Polar Knowledge Canada, Canadian High Arctic Research Station; Université du Québec à Rimouski; Wildlife Conservation Society; Manomet

Contributor Organizations

[1] U.S. Fish & Wildlife Service; [2] Polar Knowledge Canada, Canadian High Arctic Research Station; [3] Université du Québec à Rimouski; [4] Wildlife Conservation Society; [5] Manomet; [6] Smithsonian Migratory Bird Center; [7] McGill University; [8] Université de Moncton; [9] Government of Alberta; [10] National Wildlife Research Centre, Environment and Climate Change Canada; [11] Georgetown University; [12] Carleton University; [13] U.S. Geological Survey, Alaska Science Center

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